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Attorney Docket: BHT/3111/239

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Inventor: Chun-Hung LIN — Group Art Unit: 1742

Serial No.: 10/085,074 — Examiner: H. Wilkens III

Filed: March 1, 2002

For: Electropolish/Grinding Means for an Inner Surface of a Long Tube

VERIFIED TRANSLATION

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

I, Chia-Chang Lee, whose post office address is 2F, 171, Sungteh Rd., Taipei, Taiwan, R.O.C., declare as follows:

1. That I am well acquainted with both the English and Chinese languages; and

2. That the attached document is a true, correct and accurate translation made by me to the best of my knowledge and belief of Taiwan application 090221767.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statement may jeopardize the validity of the application or any patent issued thereon.

April 20, 2004
(Date)

(Signature of Translator)

Filing Date	December 13, 2001
Application No.	090221767
Classification	

Invention Patent Specification

	English	AN ELECTROPOLISHINGING/GRINDING MEANS FOR AN INNER SURFACE OF A LONG TUBE
	Chin	e
(2) Inventor (s) Nationality Residence Address(	Name(	es)Lin, Chun-Hung; Tsai, Chen-Der; Wang, Hann-Tsong; Chen, Jiun-Hung; Lin, De-Chang Republic of China No. 187, Chung Sheng St., I-Lan, Taiwan, R.O.C. No. 37-1, WuPu Li, HsinPu Town, Hsinchu, Taiwan, R.O.C. No.9, Aly. 41, Ln. 23, WuFang St., ChuTung Town, Hsinchu, Taiwan, R.O.C. No. 437, MinSheng Rd., Western District, TaiChung, Taiwan, R.O.C. 5F-1, No. 23, ChingTao E. Rd., Taipei, Taiwan, R.O.C.
(3)Applicant Name Nationality Residence Address Representive's Name		Industrial Technology Research Institute Republic of China No. 195, Sec. 4, ChungHsing Rd., Chutung Town, Hsinchu, Taiwan, R.O.C. Wong, Chen

(4) Abstr

(5) Description

Field of the Invention:

The present invention is an electropolishing/grinding means for an inner surface of a long tube, especially applied to a long tube longer than 3 meters and a diameter range under 5 cm.

Background of the Invention:

A process of electropolishing is to connect a workpiece to an anode and a metal to a cathode, aforesaid whole structure of workpiece connecting to anode and metal connecting to cathode are put into electrolyte for electrifying direct current, thus defects on workpiece surface are removed and the surface is then shining and smooth. Features of electropolishing are that improving surface cleanness, roughness, passivation, etc. For different fields of semiconductor, chemical industry, biochemical engineering, foodstuff industry, needed tubes of aforesaid fields are to deliver fluids of those fields, and inner surfaces of tubes are treated by polish or electrolysis to approach high cleanness and anti-corrosion. Especially, products of IC/LCD/III-V require high standards of cleanness and anti-corrosion, thus, applying the present invention to said products are a challenge.

In prior arts of US Patent No. 4826582 and 4849084, which are figuring out part of the technologies of electropolishing a 10-meter heat exchange tube, and an electrode device for positioning workpiece and sealing electrolyte is a must. The prior arts adopt a 3-layer structure of delivering electrolyte of high pressure air, but unfortunately said structure is very complicate and only suitable for bigger diameter workpieces, not for diameters under 3 cm.

In prior art of US Patent Number 5958195, which is the technology of electrolyzing and polishing an inner surface of a long and bended tube. However, to electrolyze and polish a bended tube, electrode must move alone bended curve for not happening short circuit. The most important parts are a flexible electrode and an insulation device. The insulation device is to avoid short circuit and non-concentricity, but it blocks electrolyte flowing and makes un-average electric field, etc.

In prior arts of US Patent Number 4601802 and 4705611, which offer a fixture applied an inside tube, and the fixture stabilizes a plurality of axially rotating tubes simultaneously. An end connector can circulate tube and exhaust gas from an upper end, and electrolyte can be recycled after overflowing. An electrode length is equal to the tube's length, therefore a huge space and a super power supplier are needed to fit such conditions.

Summary of the Invention:

The first object is to offer an electropolishinging/grinding means for an inner surface of a long tube, which improves an electrode design and applies a theory of huge and fine polishing to a same electrode means for improving a successful rate in manufacturing and an electropolishing surface and passivation effect.

The second object is to offer an electropolishinging/grinding means for an inner surface of a long tube, which can electrolyze and polish an inner surface of a tube greater than 3 meters and diameter range under 5 cm; a structure of the means is simple to save an equipment cost.

The third object is to offer an electropolishinging/grinding means for an inner surface of a long tube, which avoids short circuit and non-concentricity problems. An electrode of the present invention is installed through a center of a partition, so the electrode has a certain distance with the inner surface in tube because the partition supports electrode. Therefore, the short circuit and non-concentricity are solved; further, the average electric field is kept all the time because of the partition is round.

The fourth object is to offer an electropolishinging/grinding means for an inner surface of a long tube, which electrode can be designed as multi-section, to do so figures out that needing a huge space to store such similar equipment; further, the electrode can be added to different sections depending on needs to improve electropolishing result.

The appended drawings will provide further illustration of the present invention, together with description; serve to explain the principles of the

invention.

Brief Description of the Drawings:

Figure 1 is a scheme of a practical application of the present invention.

Figure 2 is a first preferred embodiment of the present invention.

Figure 3 is a preferred embodiment of a partition of the present invention.

Figure 4 is a scheme of a practical application of the present invention.

Figure 5 is a partial enlarged view of a preferred embodiment of a long tube of the present invention.

Figure 6 is a sectional view of a preferred embodiment of the partition of the present invention.

Figure 7 is a preferred embodiment of the long tube of the present invention.

Reference Numerals of the Elements:

10 tank

11 heater

12 switch

13 recycling tank

14 pump

15 halogen bulbs

16 tube

17 inclined platform

18 first partition

19 propeller

20 cable

21 electrode

22 axial driven mechanism

23 pipe

24 screw slideway

25 slots

26 second partition

27 driving apparatus

271 outer electromagnets

28 fixed magnet mechanism

281 fixed magnets

29 first power device

30 second power device

31 guiding rod mechanism

32 abrasive

33 spring

34 holes

35 thimble

Detailed Description of the Invention:

For different fields of semiconductor, chemical industry, biochemical

engineering, foodstuff industry, inner surfaces of needed tubes of aforesaid fields are treated by electrolyzing and polishing for improving surface cleanness, roughness and passivation results. The present invention comprises an electrolyte delivering system, which makes electrolyte averagely pass through an inner surface of a long tube; a cable, which guides direct current to a working area of an inner surface of tube, and electrolyte is an electrifying media to make a complete electric path, wherein a magnetic-levitated device can be added on, which drives electrode axial motion and revolving motion, further to avoid a contact of a negative electrode and the positive inner surface. Plural places of radial top of the partition are installed some abrasive blocks as Al_2O_3, etc., and the abrasive blocks cooperates with plural closed fillisters, springs and thimbles for constantly keeping the abrasive blocks onto the inner surface, results of grinding and electropolishinging are then achieved.

Referring to Figure 1, which is a scheme of a practical application of the present invention. Electrolyte is stored in a tank 10. There is a heater 11 in the tank 10 to keep warming and heating the electrolyte. Electrolyte passes through a switch 12 and a pipe 23 to a tube 16, wherein the switch 12 is made of Teflon or other heat-resistant and acid-proof materials. The tube 16 is placed on an inclined platform 17, and thus a higher end of tube 16 connects to the pipe 23 for electrolyte passing from higher end to a lower end. Inclined angles of the inclined platform 17 can be adjusted to control electrolyte flowing speeds. Tube 16 has an electropolishinging device inside, which connects to a first power device 29 via a cable 20; the first power device 29 supplies direct current for electropolishinging reaction. The present invention adopts that electron exchanging from an anode half reaction and a cathode half reaction to generate an electropolishinging result. Tube 16 is anode, thus an inner surface of tube 16 is anode, and anode looses electrons; the electrode is cathode, and cathode receives electrons; Figure 1 does not show the electrode, so only cable 20 is shown up to represent above connection relationship. Tube 16 is about 2 meters long or more than that, so electrolyte temperature is lower when electrolytes approaching to a lowest end of tube 16, thus plural halogen bulbs 15 are placed around tube 16 for heating. Electrolyte is recycled after passing through tube 16 to a recycling tank 13, then it

is delivered back to tank 10 by a pump 14 with heat-resistant and acid-proof. A driving apparatus 27 is set surround tube 16 and has several outer electromagnets inside (not shown in the Figure); when the outer electromagnets cooperating with a second power device 30, generating electromagnetic to associate with plural fixed magnets for revolving the fixed magnets, thus the electropolishinging device in tube 16 is in rotating motion. An axial driven mechanism 22 carries the driving apparatus 27 and mounts on a guiding rod mechanism 31; Cooperation of the axial driven mechanism 22 and the guiding rod mechanism 31 is thus to move the driving apparatus 27 which parallel to the tube 16. For the embodiment, axial driven mechanism 22 moves from lower to higher when electropolishinging reaction is processed for exhausting air bubbles generated by reaction. As aforesaid, which is a complete process and will be described in detail as following.

Referring to Figure 2, which is a first preferred embodiment of the present invention. The embodiment applies to polish an inner surface of the tube 16, which is longer than 3 meters and made of SUS300 series without polarization. The embodiment comprises a fixed magnet mechanism 28 including plural fixed magnets 281, which adopt axial longest sides of themselves for being combined and formed to become the fixed magnet mechanism 28; at least one electrode 21, which is made of copper and tungsten, an end of the electrode 21 is bounded a cable 20, which connects to a first power device 29 outside of the tube 16 for power supply; at least two partitions, which is made of Teflon or materials without electric conductivity for limiting electropolishinging range, and it is to save power and enhancing electropolishinging result. Please refer to Figure 3, which is a preferred embodiment of a partition of the present invention, plural slots 25 are designed on an outer edge of partition, the slots make electrolyte flow close to inner surface more fluently, a boundary layer is then broken to generate an average anode membrane, thus air bubbles generated by electropolishinging are exhausted fast; further, the partitions 18 and 26 has many holes as meshes for fluently introducing electrolyte, to avoid contact of negative electrode 21 and positive inner surface and figure out non-average polishing of eccentric electrode, dimensions of the partitions cannot be enlarged, the present invention takes the driving apparatus 27 and the fixed magnet mechanism 28 to form a magnetic

levitation effect, which means using magnetic repulsiveness and magnetic attraction to keep away from the partitions and inner surface and avoid the eccentric situation, the first partition 18 is on an electrode 21 end opposite another end connecting to the cable 20, the second partition 26 is placed on another end of the electrode 21, thus the two ends of the fixed magnet mechanism 28 are individually the first partition 18 and the second partition 26; further, the fixed magnet mechanism 28 is radially and averagely distributed on the two partitions, a surface of the second partition 26 connecting to the fixed magnet mechanism 28 which opposite side is installed a propeller mechanism, and the propeller mechanism can be a propeller or as shown in Figure 7, which is a preferred embodiment of the long tube of the present invention, which means a screw slideway 24, and it is to fast remove air bubbles generated from electropolishinging reaction; the driving apparatus 27, which comprises plural outer electromagnets 271 distributed around the tube 16, and relative position in the tube 16 is fixed magnet mechanism 28, which connects to the second power device 30 for supplying power to outer electromagnets 271; and the axial driven mechanism 22, which carries both the driving apparatus 27 and the second power device 30 for axially moving aforesaid apparatus and device, the moving speed is from 5 to 20 cm/min. Electrode 21, two partitions 18 and 26 and fixed magnet mechanism 28 are in tube 16, and they cooperate with driving apparatus 27, thus, electromagnet force is going to drive fixed magnets 281 in fixed magnet mechanism 28, therefore electrode 21, two partitions 18 and 26 and fixed magnet mechanism 28 are rotated along their same axis; axial driven mechanism 22 simultaneously drives driving apparatus 27 and second power device 30, and the present invention also moves parallel to the axis; finally when electrode 21 connects to first power device 29, a complete electropolishinging reaction in a long tube is done.

As mentioned above, driving apparatus 27 is an electromagnet apparatus, when driving apparatus 27 connects to second power device 30, plural outer electromagnets 271 are then driven, and plural fixed magnets 281 in fixed magnet mechanism 28 are in rotation as well, which rotation speed is 10 to 200 rpm; on the other hand, driving apparatus 27 is a rotational mechanism, when driving

apparatus 27 connects to second power device 30, plural outer electromagnets 271 in driving apparatus 27 are driven via direct mechanical transmission, and plural fixed magnets 281 in fixed magnet mechanism 28 are in rotation as well.

Please refer to Figure 4, which is a scheme of a practical application of the present invention and a preferred embodiment of electropolishinging of the present invention. The embodiment is that placing the electrode on a front place, and a front end of electrode is bounded by cable 20, which connects to first power device 29; when electropolishinging action is in moving, axial driven mechanism 22 is also in moving from higher to lower for exhausting particles generated by polishing.

Referring to Figure 5, which is a partial enlarged view of a preferred embodiment of a long tube of the present invention, which is applied to the inner surface of tube 16 full of electrolyte, and tube 16 is made of SUS300 series without polarization and longer than 3 meters, and comprising: the fixed magnet mechanism 28, including plural fixed magnets 281, which adopt axial longest sides of themselves for being combined and formed to become the fixed magnet mechanism 28; at least one electrode 21, which is made of copper and tungsten, an end of the electrode 21 is bounded a cable 20, which connects to the first power device 29 outside of the tube 16 for power supply; at least two partitions, which is made of Teflon or materials without electric conductivity for limiting electropolishinging range, and it is to save power and enhancing electropolishinging result. Please refer to Figure 3, which is a preferred embodiment of a partition of the present invention, plural slots 25 are designed on an outer edge of the first partition 18, the slots 25 make electrolyte flow close to inner surface more fluently, a boundary layer is then broken to generate an average anode membrane, thus air bubbles generated by electropolishinging are exhausted fast; further as shown in Figure 3, the partitions 18 and 26 has many holes 34 as meshes for fluently introducing electrolyte, to avoid contact of negative electrode 21 and positive inner surface and figure out non-average polishing of eccentric electrode, dimensions of the partition 18 cannot be enlarged, the present invention takes the driving apparatus 27 (not shown in Figure 5) and the fixed magnet mechanism 28 to form a magnetic levitation effect, which means using magnetic

repulsiveness and magnetic attraction to keep away from the partitions and inner surface and avoid the eccentric situation, the first partition 18 is on an electrode 21 end opposite another end connecting to the cable 20, the second partition 26 is placed on another end of the electrode 21, thus the two ends of the fixed magnet mechanism 28 are individually the first partition 18 and the second partition 26; further, the fixed magnet mechanism 28 is radially and averagely distributed on the two partitions; referring to Figure 6, which is a sectional view of a preferred embodiment of the partition of the present invention, there are plural closed fillisters placed on radial end of the second partition 26, and each of the closed fillister has a spring 33 and a thimble 35. The thimble 35 protrudes outside the radial end and supports an abrasive 32 made of Al_2O_3, and the abrasive 32 continuously supports the inner surface of tube for grinding. Following components of the present embodiment can be same as Figure 2, which comprises driving apparatus 27, including plural outer electromagnets 271 distributed around the tube 16, and relative position in the tube 16 is fixed magnet mechanism 28, which connects to the second power device 30 for supplying power to outer electromagnets 271; and the axial driven mechanism 22, which carries both the driving apparatus 27 and the second power device 30 for axially moving aforesaid apparatus and device, the moving speed is from 5 to 20 cm/min. Electrode 21, two partitions 18 and 26 and fixed magnet mechanism 28 are in tube 16, and they cooperate with driving apparatus 27, thus, electromagnet force is going to drive fixed magnets 281 in fixed magnet mechanism 28, therefore electrode 21, two partitions 18 and 26 and fixed magnet mechanism 28 are rotated along their same axis; axial driven mechanism 22 simultaneously drives driving apparatus 27 and second power device 30, and the present invention also moves parallel to the axis; finally when electrode 21 connects to first power device 29, a complete electropolishinging reaction in a long tube is done.

As mentioned above, driving apparatus 27 is an electromagnet apparatus, when driving apparatus 27 connects to second power device 30, plural outer electromagnets 271 are then driven, and plural fixed magnets 281 in fixed magnet mechanism 28 are in rotation as well, which rotation speed is 10 to 200 rpm; on the other hand, driving apparatus 27 is a rotational mechanism, when driving

apparatus 27 connects to second power device 30, plural outer electromagnets 271 in driving apparatus 27 are driven via direct mechanical transmission, and plural fixed magnets 281 in fixed magnet mechanism 28 are in rotation as well.

The electrode of the present invention can not be limited to one and can be extended practically to a design of multi-electrodes for improving effects of electropolishing and grinding. Therefore, summing up those mentioned above, the present invention in fact utilizes ordinary means ingeniously so as to achieve effects beyond expectation.

While the present invention has been shown and described with reference to preferred embodiments thereof, and in terms of the illustrative drawings, it should be not considered as limited thereby. Thus, the present invention is infinitely used. However, various possible modification, omission, and alterations could be conceived of by one skilled in the art to the form and the content of any particular embodiment, without departing from the scope and the sprit of the present invention.

(6) Claims

1) An electropolishinging means for an inner surface of a long tube, which applied to polish the inner surface of the long tube full of electrolyte and comprises:

a fixed magnet mechanism having plural fixed magnets, and each axial longest side of every fixed magnet being combined and formed to become the fixed magnet mechanism;

at least one electrode having a cable bounded on one end of the electrode, the cable connecting to a first power device outside of the long tube for supplying power;

at least two partitions, which being a first partition and a second partition, the first partition being placed on an opposite end of the end of electrode bounding the cable, the second partition being axially placed on another end of the fixed magnet mechanism comparing to an end of the fixed magnet mechanism with the first partition, fixed magnet mechanism being radially and averagely distributed on the two partitions;

a driving apparatus having plural outer magnets around the tube, and a relative position in the tube being fixed magnet mechanism, which connecting to a second power device for supplying power to outer electromagnets; and

an axial driven mechanism carrying both the driving apparatus and the second power device for axially moving said apparatuses and devices;

said electrode, two partitions and fixed magnet mechanism being in long tube and cooperating with driving apparatus, thus, electromagnet force driving fixed magnet in fixed magnet mechanism, therefore electrode, two partitions and fixed magnet mechanism being rotated along their same axis; axial driven mechanism simultaneously driving driving apparatus and second power device, and the means moving parallel to the axis; a whole electropolishinging reaction in a long tube being completed when electrode connecting to first power device.

2) The electropolishinging means for an inner surface of a long tube as cited in

claim 1, wherein the partitions are made of material without electric conductivity.

3) The electropolishinging means for an inner surface of a long tube as cited in claim 1, wherein plural slots are on an outer edge of partitions, the slots make electrolyte flow close to inner surface more fluently.

4) The electropolishinging means for an inner surface of a long tube as cited in claim 1, wherein the partitions have many holes as meshes for fluently introducing electrolyte.

5) The electropolishinging means for an inner surface of a long tube as cited in claim 1, wherein dimensions of the partitions need not be enlarged, driving apparatus and fixed magnet mechanism are to form a magnetic levitation effect, which means using magnetic repulsiveness and magnetic attraction to keep away from the partitions and inner surface and avoid the eccentric situation.

6) The electropolishinging means for an inner surface of a long tube as cited in claim 1, wherein a screw mechanism is designed on an end of second partition opposite to the end of second partition with fixed magnet mechanism to fast remove air bubbles generated from electropolishinging reaction.

7) The electropolishinging means for an inner surface of a long tube as cited in claim 6, wherein the screw mechanism is one of the following: propeller, slideway.

8) The electropolishinging means for an inner surface of a long tube as cited in claim 1, wherein driving apparatus is an electromagnet apparatus, when driving apparatus connects to second power device, plural outer electromagnets are then driven, and plural fixed magnets in fixed magnet mechanism are in rotation as well.

9) The electropolishinging means for an inner surface of a long tube as cited in claim 1, wherein driving apparatus is a rotational mechanism, when driving apparatus connects to second power device, plural outer electromagnets in driving apparatus are driven via direct mechanical transmission, and plural

fixed magnets in fixed magnet mechanism are in rotation as well.

10) An electropolishinging/grinding means for an inner surface of a long tube, which applied to polish the inner surface of the long tube full of electrolyte and comprises:

a fixed magnet mechanism having plural fixed magnets, and each axial longest side of every fixed magnet being combined and formed to become the fixed magnet mechanism;

at least one electrode having a cable bounded on one end of the electrode, the cable connecting to a first power device outside of the long tube for supplying power;

at least two partitions, which being a first partition and a second partition, the first partition being placed on an opposite end of the end of electrode bounding the cable, the second partition being axially placed on another end of the fixed magnet mechanism comparing to an end of the fixed magnet mechanism with the first partition, fixed magnet mechanism being radially and averagely distributed on the two partitions, plural closed fillisters being placed on a radial end of the second partition, and each of the closed fillister having a flexible element and a protruding object, the protruding object protruding outside the radial end and supporting an abrasive, and the abrasive continuously supporting the inner surface of tube for grinding;

a driving apparatus having plural outer magnets around the tube, and a relative position in the tube being fixed magnet mechanism, which connecting to a second power device for supplying power to outer electromagnets; and

an axial driven mechanism carrying both the driving apparatus and the second power device for axially moving aforesaid apparatuses and devices;

said electrode, two partitions and fixed magnet mechanism being in long tube and cooperating with driving apparatus, thus, electromagnet force driving fixed magnet in fixed magnet mechanism, therefore electrode, two partitions and fixed magnet mechanism being rotated along their same axis; axial driven

mechanism simultaneously driving driving apparatus and second power device, and the means moving parallel to the axis; a whole electropolishinging/grinding reaction in a long tube being completed when electrode connecting to first power device.

11) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein plural slots are on an outer edge of the first partition, the slots make electrolyte flow close to inner surface more fluently.

12) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein the first partition has many holes as meshes for fluently introducing electrolyte.

13) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein dimensions of the first partition need not be enlarged, driving apparatus and fixed magnet mechanism are to form a magnetic levitation effect, which means using magnetic repulsiveness and magnetic attraction to keep away from the partitions and inner surface and avoid the eccentric situation.

14) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein the flexible element is a spring.

15) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein the abrasive is made of Al_2O_3.

16) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein driving apparatus is an electromagnet apparatus, when driving apparatus connects to second power device, plural outer electromagnets are then driven, and plural fixed magnets in fixed magnet mechanism are in rotation as well.

17) The electropolishinging/grinding means for an inner surface of a long tube as cited in claim 10, wherein driving apparatus is a rotational mechanism, when driving apparatus connects to second power device, plural outer electromagnets in driving apparatus are driven via direct mechanical transmission, and plural

fixed magnets in fixed magnet mechanism are in rotation as well.

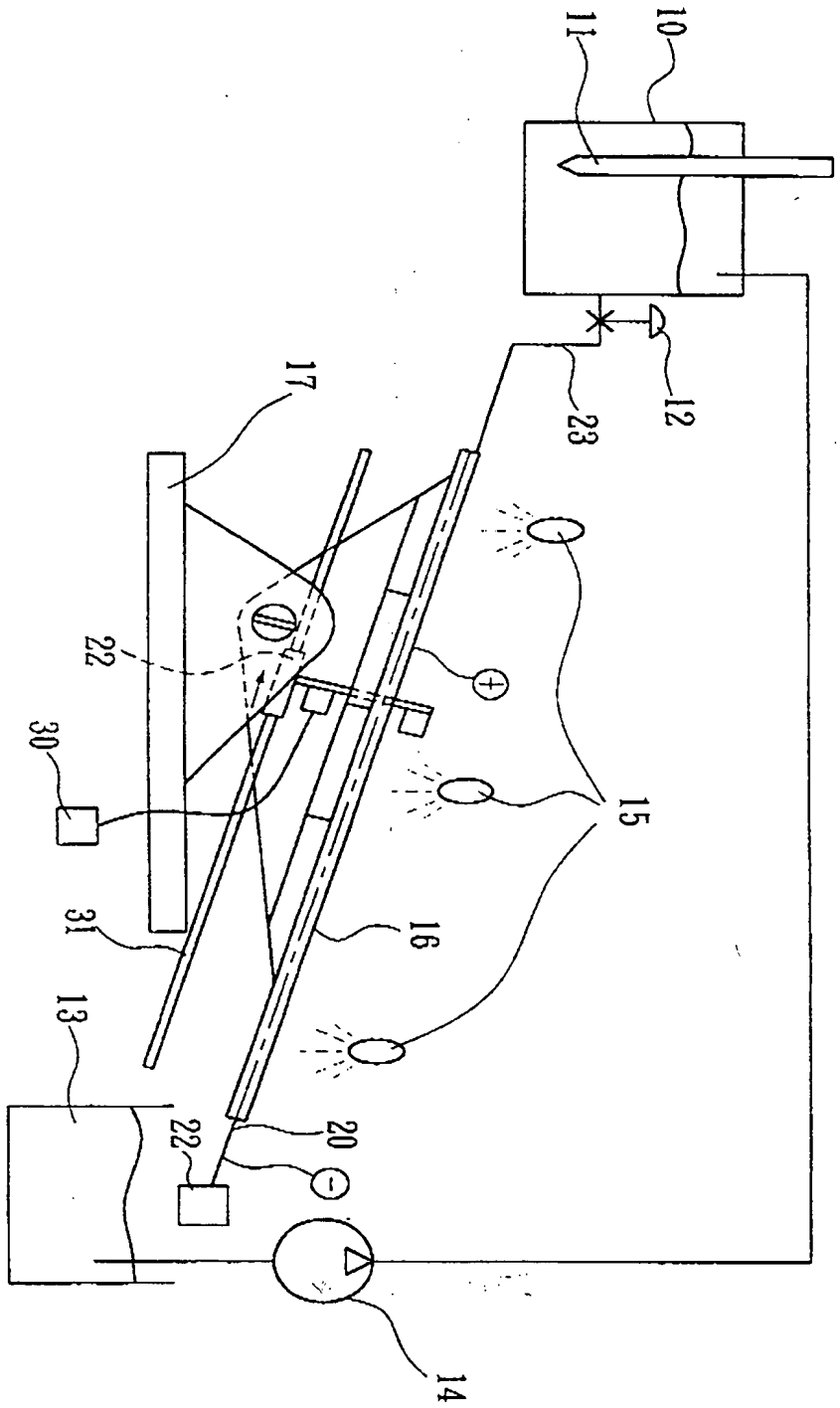

FIG. 1

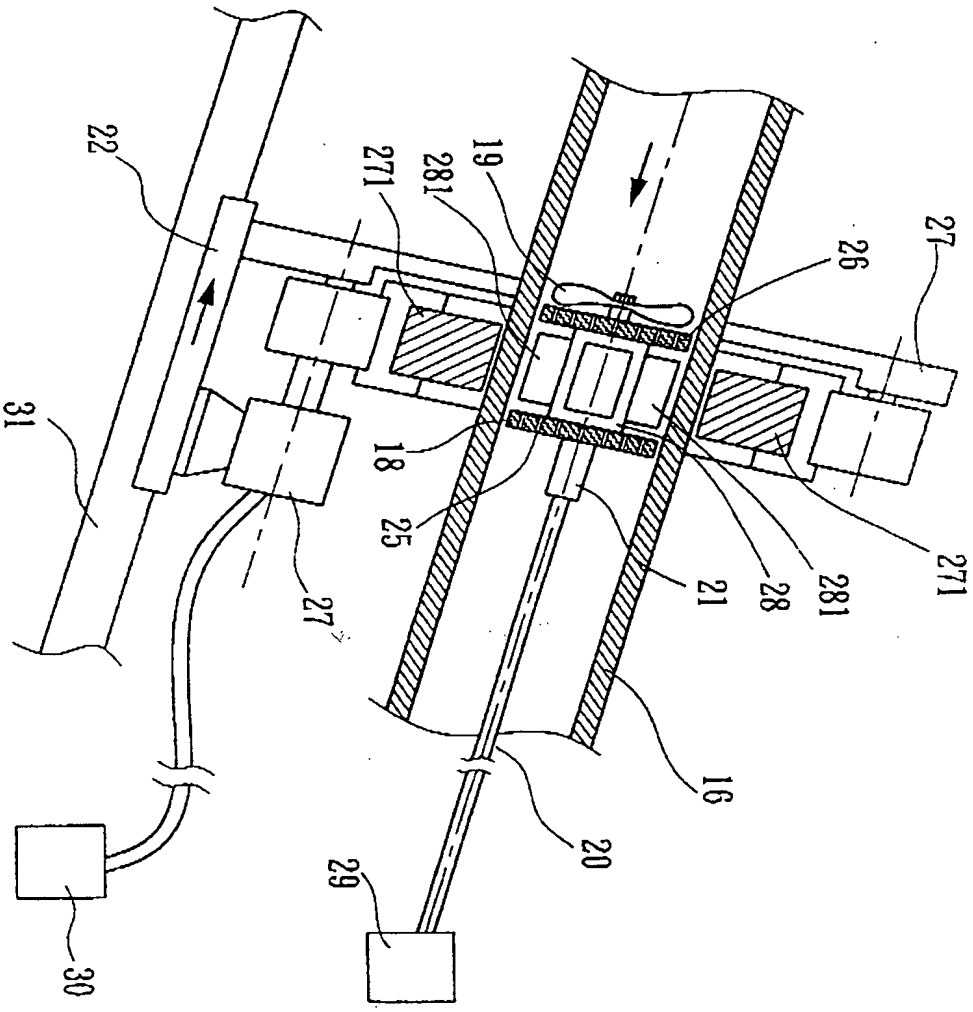

FIG. 2

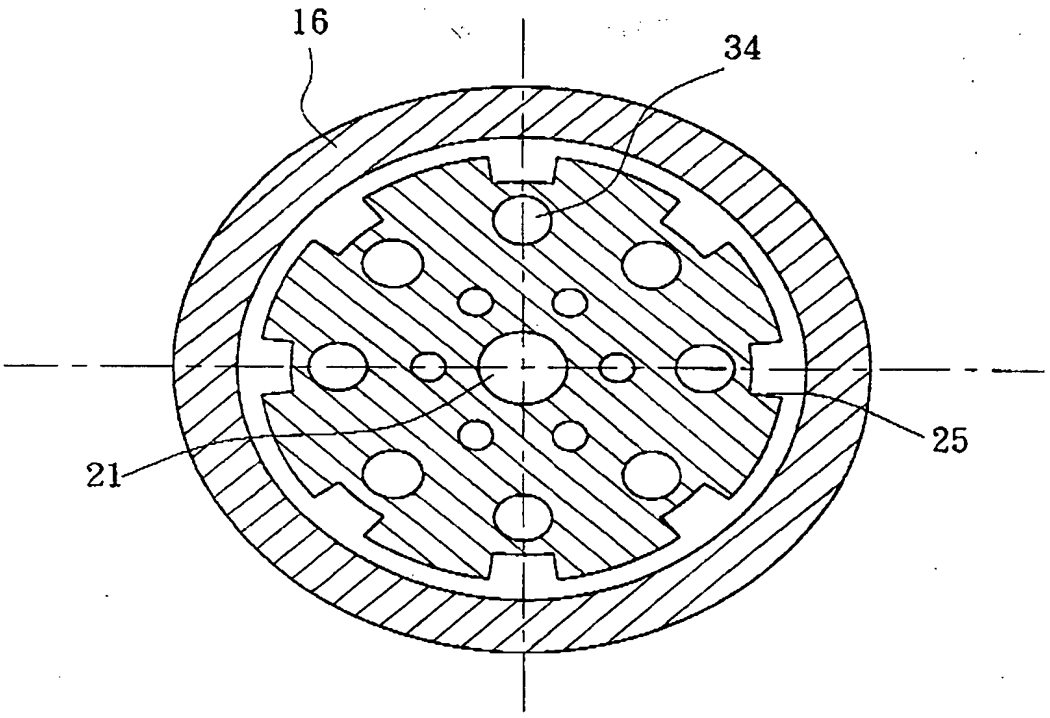

FIG. 3

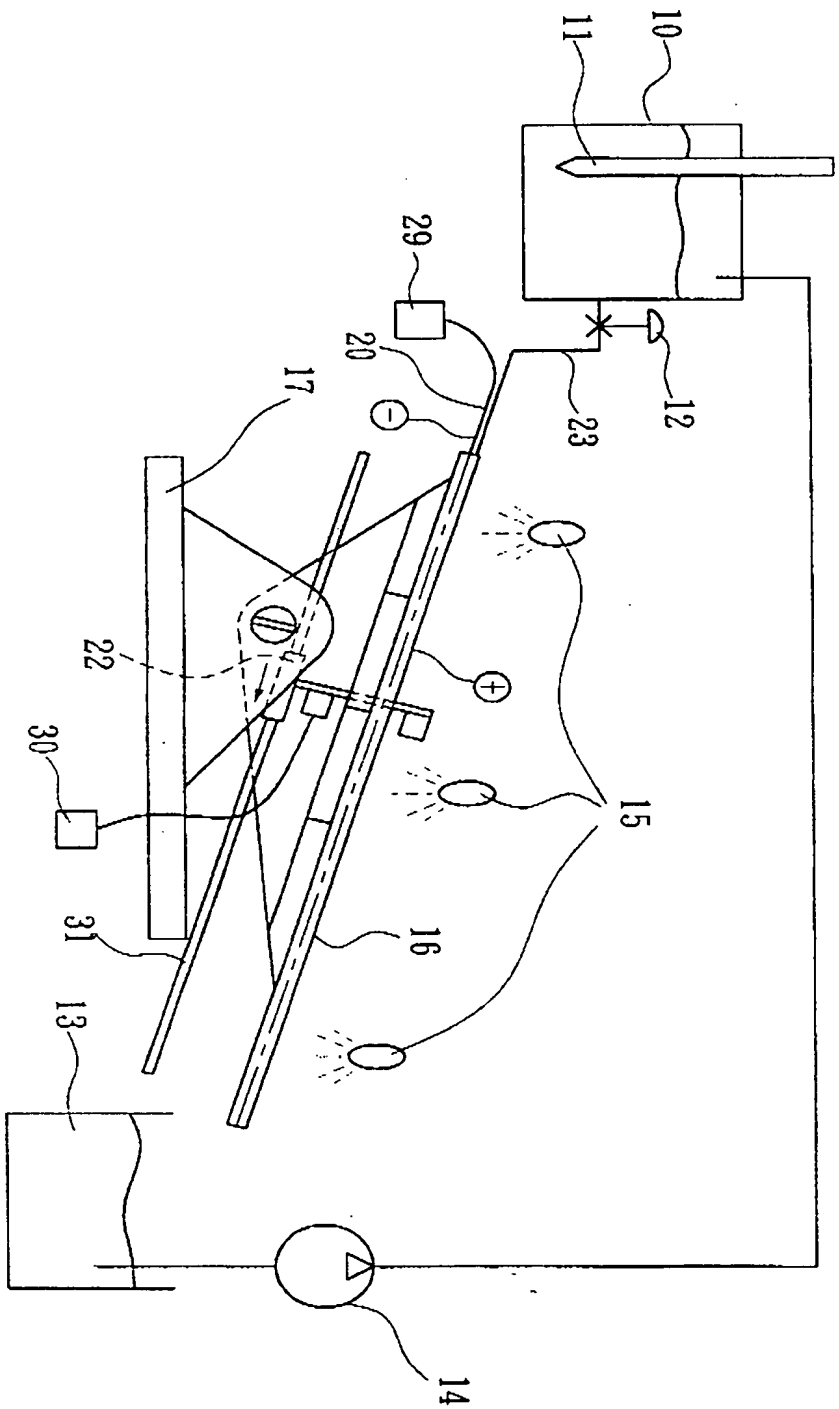

FIG. 4

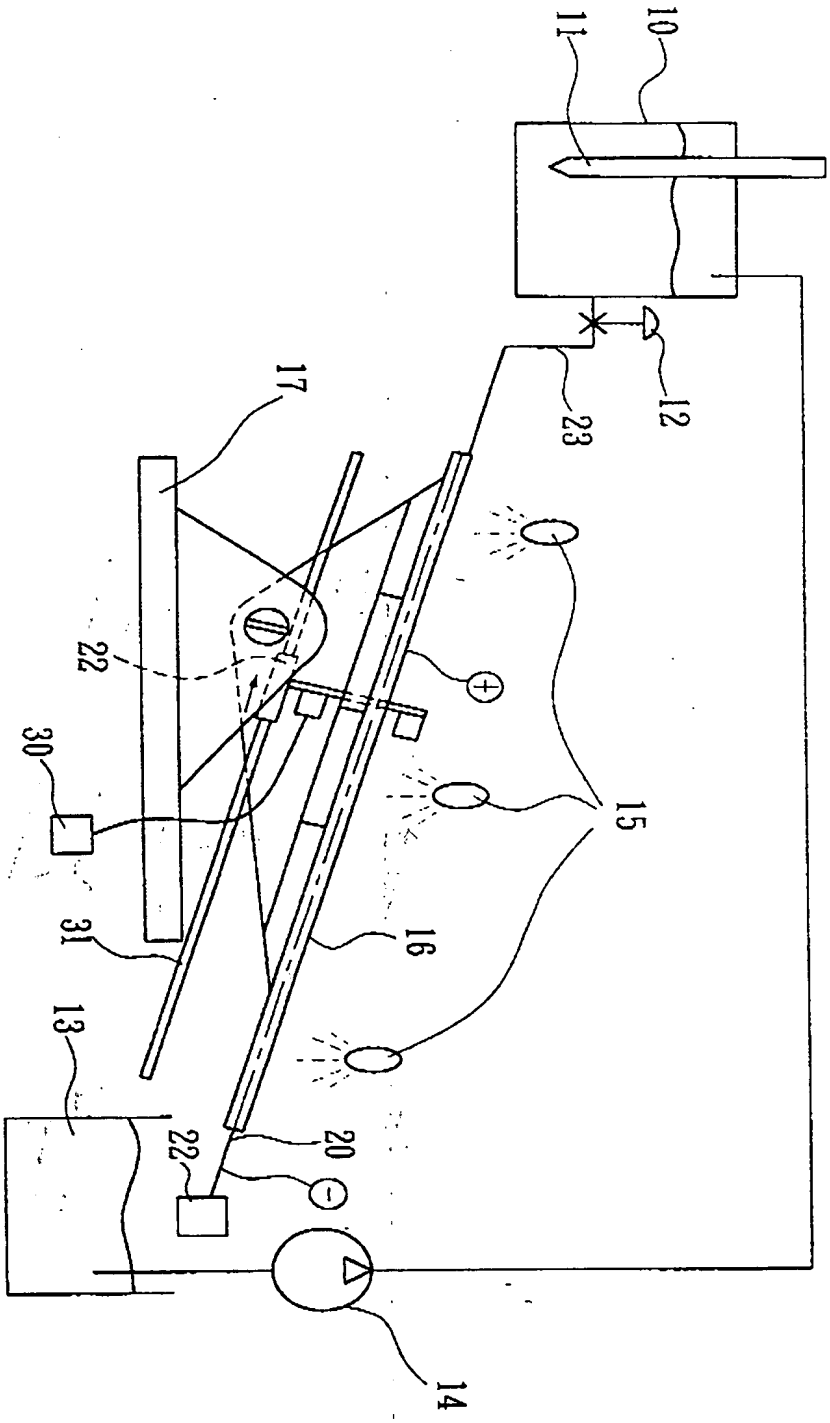

FIG. 1

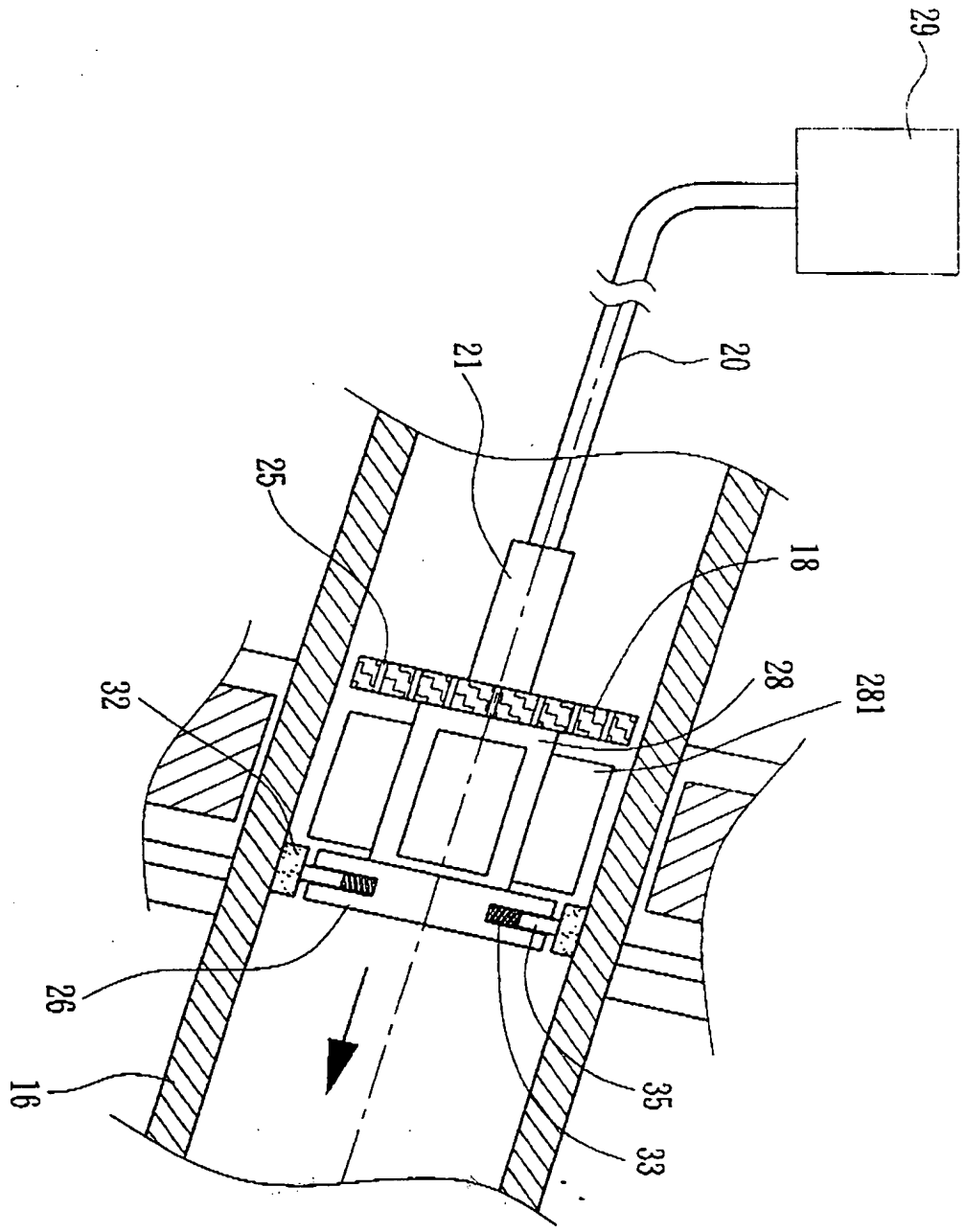

FIG.5

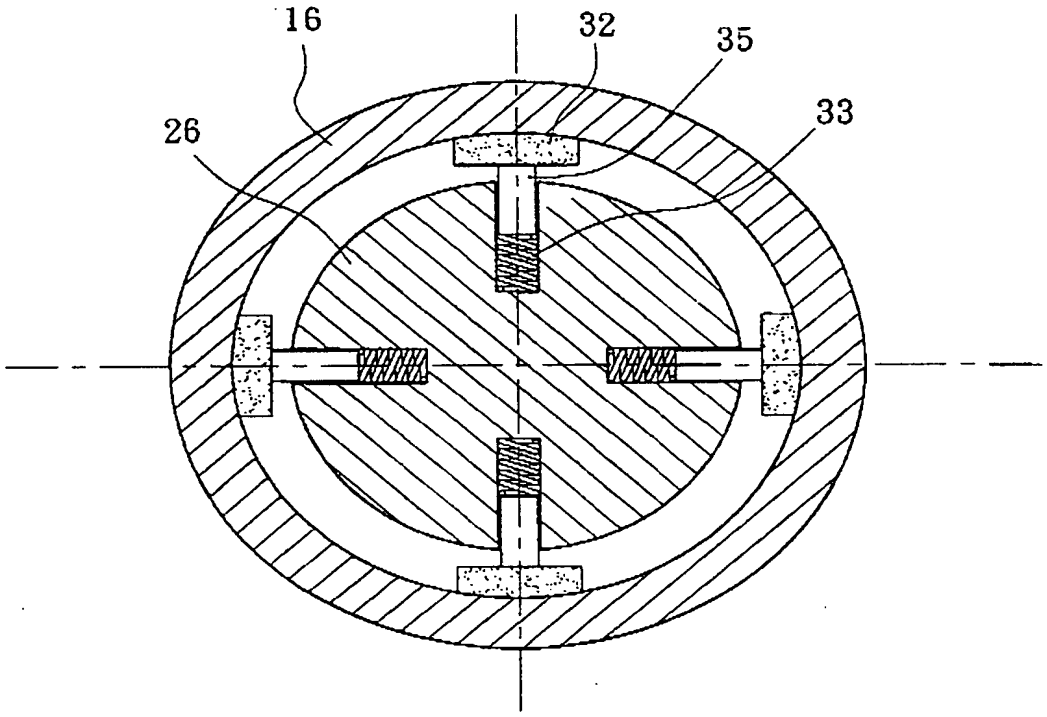

FIG. 6

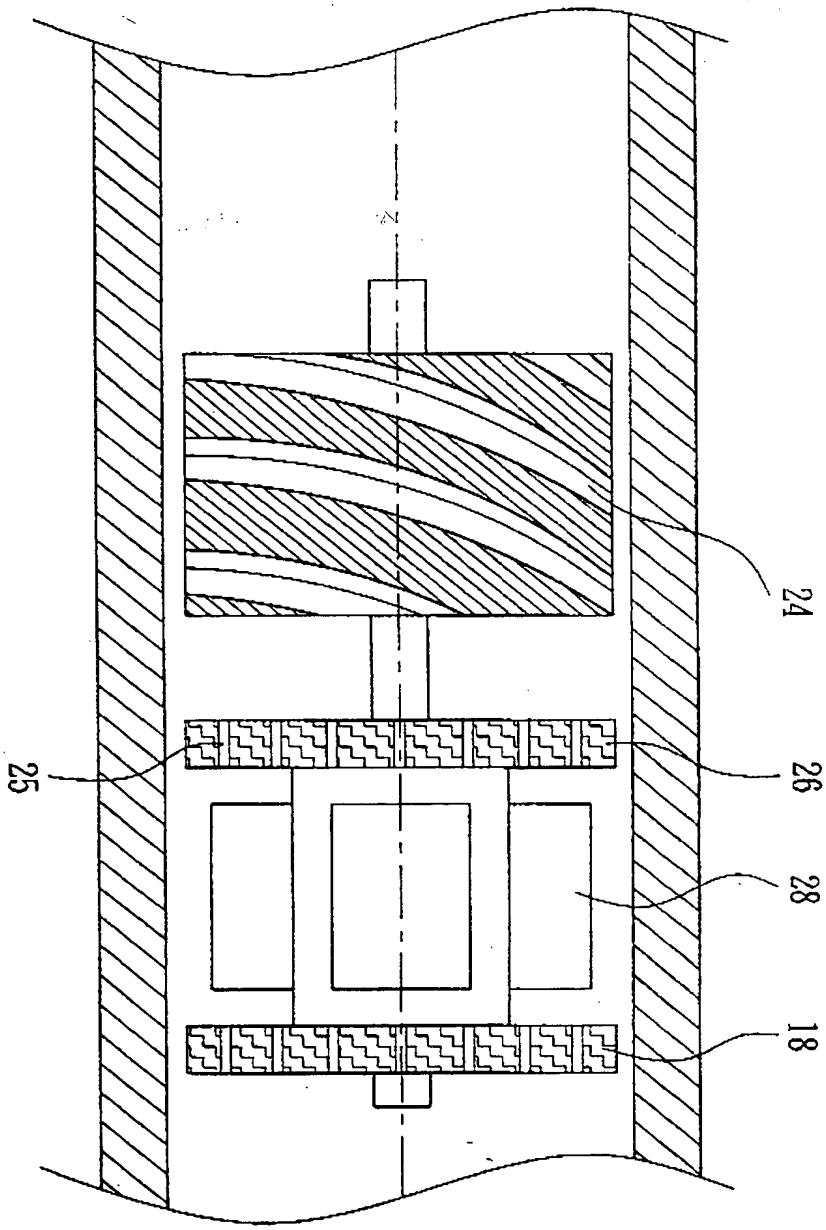

FIG. 7

申請日期	
案號	
類別	

A4
C4

（以上各欄由本局填註）

發明 新型 專利說明書

一、發明新型名稱	中文	一種長管內表面電解拋光／研磨裝置
	英文	
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	代表人姓名	翁政義

C7
D7

五、創作說明（ / ）

創作之技術領域：

本創作係有關於一種長管內表面電解拋光/研磨裝置，尤指一種應用於長度為三公尺以上、管徑為二英吋以下的長管內表面拋光的裝置。

創作之背景：

按，電解拋光乃是將工件接於陽極，以某種金屬接於陰極，置於電解液中通以直流電，以電解作用將工件表面金屬移除，亦即反電解作用，使工件表面有光澤化與平坦化之效果。其特色包括改善其表面潔淨度〈clean〉、粗糙度〈roughness〉、鈍化〈passivation〉效果等。在半導體/化工/生醫/食品等產業所需使用之流體輸送長管之內表面，絕大部分需經過研磨或電解拋光處理，以達到高潔淨與抗腐蝕的目的，尤其是日益精進的IC/LCD/III-V〈如砷化鋁、氮化硼、砷化鎵、磷化鎵、砷化銦、磷化銦、磷化鋁、氮化鎵、銻化鋁、銻化鎵等〉族產業，對上述要求標準日趨嚴苛，對於應用本技術所衍生的產品如長管的均勻性與良率都將是一製程與設備的挑戰。

習知技術中美國專利案第4826582號與4849084號的部分，係解決長直管內部部分區域，其電解拋光施工於十公尺長的熱交換管所需要的技術，因此需要能定位且密封電解液的電極機構。其採用三層機構，以高壓氣體輸送電解液裝置，如是，則其構造複雜且僅適用於大管徑工件，不適用於一英吋以下之管徑。

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五、創作說明（2）

習知技術中如美國專利案第5958195號的部分，係提出一套適用於長且彎曲之長管內電解拋光製程系統；然而要進行彎曲管內的電解拋光，電極必須可隨彎曲處行進而不會短路。整個專利重點就在於撓性電極的設計與絕緣機構的設計；但為配合可彎曲之流道所採用之撓性電極，其絕緣機構的設計係避免短路與同心度之問題，反而阻擋電解液流通，並且其機構將造成電場分布不均勻等衍生問題。

習知技術中如美國專利案第4601802號與4705611號的部分，係提出一套用於內部電解拋光長管之夾治具，可同時處理複數隻水平放置並軸向旋轉之長管，尾端接頭包括可使長管旋轉並自上端排出氣體，且使電解液溢流後回收。但其電極長度與直管長度相當，因此需大量的廠房空間與超大的電源供應器，以提供所需的電流。

創作之簡要說明：

本創作之第一目的係在於提供一種長管內表面電解拋光/研磨裝置以改進電極設計，亦即將大電流拋光製造程序與小電流拋光製造程序之兩種電解拋光原理設計應用於同一組電極裝置，藉以改善製程良率與增進電解拋光之表面粗糙度與鈍化效果之等級。

本創作之第二目的係在於提供一種長管內表面電解拋光/研磨裝置，使該裝置可針對長管長三公尺以上、長管內徑小於二英吋的長管進行管內表面電解拋光/研磨反應，且該裝置的結構簡單明確，可節省設備方面的成本。

本創作之第三目的係在於提供一種長管內表面電解拋光/研磨裝置，使電解拋光作用在進行的時候不會有短路與同心

五、創作說明（ 7 ）

度之虞。由於本創作之電極係穿設於隔板之中心部位，因此藉著隔板的支持與電磁力造成之磁浮效應，該電極與長管內表面之距離始終保持一致，如是者，短路與同心度的問題將可迎刃而解；甚且，該電場的均勻度亦因著圓形隔板而保持者。

本創作之第四目的係在於提供一種長管內表面電解拋光/研磨裝置，係因其電極可為多段式的設計，將免除習知技術中需要極大空間儲存該設備的問題；且因著本創作可依據不同的需求而加接不同的電極，更可增加其拋光的程度。

為使　貴審查委員能對本創作之目的、特徵及功效有進一步的瞭解與認知，茲配合圖示詳加說明如后：

圖式之說明：

圖一係本創作電解拋光實際應用之簡單圖。

圖二係本創作電解拋光之一較佳實施例。

圖三係本創作電解拋光中隔板之一較佳實施例剖面圖。

圖四係本創作電解拋光研磨實際應用之簡單圖。

圖五係本創作電解拋光研磨之長管內一較佳實施例之局部放大圖。

圖六係本創作電解拋光研磨中隔板之一較佳實施例剖面圖。

圖七係本創作電解拋光之長管內一較佳實施例。

圖式中之圖號說明：

10 儲存槽

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五、創作說明（4）

11 加熱器
12 轉接器
13 回收槽
14 幫浦
15 鹵素燈泡
16 長管
17 傾斜平台
18 第一隔板
19 螺旋槳
20 導電電纜
21 電極
22 軸向機構
23 管路
24 螺旋導軌
25 溝槽
26 第二隔板
27 驅動機構
271 外電磁鐵
28 固定磁鐵機構
281 固定磁鐵
29 第一電源裝置
30 第二電源裝置
31 導桿裝置
32 研磨物

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五、創作說明（5）

33 彈簧

34 孔

35 頂出物

創作之詳細說明：

半導體/化工/生醫/食品等產業所需使用之流體輸送長管之內表面，絕大部分需經過電解拋光處理，以改善其表面潔淨度、粗糙度與鈍化效果。本創作之一種長管內表面電解拋光/研磨裝置，係包括一電解液輸送系統，以使電解液可通過需均勻拋光之長管內表面；以及一導電纜線，其可將直流電源導入長管內之工作區域；透過電解液與管壁，形成一導電通路，其中此導電極機構可加裝一磁浮裝置，除可帶動電極軸向與轉動運動外，更可避免使負導電極與正導電管壁碰觸，形成短路以致於影響拋光品質。同時可於隔板頂端加裝細微研磨物〈abrasive〉，如Al_2O_3等材質，並配合隔板內設之封閉式凹槽與彈簧、頂出物，可保證研磨物永遠與管壁接觸，同時達到研磨與電解拋光之效果。

請參考圖一所示，其係本創作電解拋光實際應用之簡單圖。電解液儲存於儲存槽10中，由於該電解液需保持在一定的溫度內，故加裝一加熱器11以進行保溫與加熱的動作。該電解液經由一轉接器12與一週邊管路23而被導引至一長管16中，其中該轉接器12係由鐵氟龍〈Teflon〉或其他耐高溫強酸材質所製成。該長管16係置放於一傾斜平台17上，呈現管路23接著長管16的一端較高，而另一端較低之勢，以方便

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五、創作說明（ 6）

電解液由高往低流的所需；該傾斜平台17係可調整其傾斜度，以控制電解液的流速。長管16內具一電解拋光裝置〈圖中未示〉，且與一導電電纜20連接至一第一電源裝置29，該第一電源裝置29係一提供直流電電源，以滿足電解拋光反應的所需。本創作係利用化學反應中陽極半反應與陰極半反應的電離子的置換反應，而產生電解拋光的作用。故，如圖一所示，該長管16係反應中的陽極，故其長管內面亦為陽極，陽極會失去電子；該電極係陰極，陰極會得到電子，然圖中未示電極，故僅以連接電極的該導電電纜20示之。在電解液流動於長管16中，由於長管長度通常超過三公尺，故由高端流至低端時，其溫度會下降，因此在長管16週邊加上複數個鹵素燈泡15以進行加熱保溫的動作。當電解液流出長管16時，會進入回收槽13中以回收電解液。電解液會經由一耐高溫強酸材質的幫浦14再打入儲存槽10中。一驅動機構27係環繞設置於長管16外，且該驅動機構內含有複數個外電磁鐵〈圖中未示〉，經與一第二電源裝置30通電後，該外電磁鐵所產生之電磁力會與長管16內之電解拋光裝置所含之複數個固定磁鐵〈圖中未示〉作用，由外電磁鐵之交互作用，而令固定磁鐵進行轉動運動；如此，將會帶動長管16內之裝置旋轉。一軸向機構22係承接該驅動機構27，且座落於一導桿裝置31，藉由該軸向機構22與導桿裝置31的配合，驅動機構27即可進行平行於長管16的移動。以本實施例而言，當電解拋光反應進行時，軸向機構22係由低往高處移動，以便利電解反應時產生的氣泡之排除。如以上所述，係一完整的電解拋光

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五、創作說明（ 7 ）

程序；然就詳細的技術內容將由以下所述。

請參考圖二所示，係本創作電解拋光之一較佳實施例，係應用於拋光至少一內部充滿電解液長管16之管徑內面，且該長管16之長度係大於3公尺，並以SUS300系列之無極性材料製成，包括有：一固定磁鐵機構28，係包含複數個固定磁鐵281，其以每單一磁鐵的最長邊為軸向邊界而成型為該固定磁鐵機構28；至少一電極21，係以銅或鎢材質製成，該電極21之一端係繫有一導電電纜20，該導電電纜20外接於該長管16外之一第一電源裝置29，以提供電源；至少二隔板，係由鐵氟隆(Teflon)或不導電材質製成，為限制電解拋光範圍，主要可節省總電源使用，並加強電解拋光效果；請見圖三所示，係本創作電解拋光中隔板之一較佳實施例剖面圖，隔板之週邊係設計有溝槽25，以帶動管壁邊緣之電解液流動，破壞其邊界流效應，使陽極膜均勻化的產生，更可有效地將電解所產生的氣泡快速排除；另有，為使電解液流動不受限制，隔板18與26可鑽複數個孔34，如網狀分布，以順暢導通電解液流動；且為避免導負電之電極21與導正電之管壁接觸，而造成短路影響製程品質，以及解決電極偏心所造成電解拋光不均勻等現象，隔板之尺寸不需加大，係驅動機構27與固定磁鐵機構28通電後形成一磁浮效應，即磁性兩極的相吸與排斥使隔板不致碰觸管徑內面與避免偏心現象；其中該第一隔板18係裝設於該電極21連接該導電電纜20之端的相反端，另該第二隔板26係沿著軸向隔著該固定磁鐵機構28與該第一隔板18分別設置於該固定磁鐵機構28之兩端，且該固定磁鐵機構

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五、創作說明（ 8 ）

28係呈徑向均勻分布於該二隔板上，該第二隔板26連接固定磁鐵機構28之面的相反面係裝設一螺旋機構，該螺旋機構可以是螺旋槳19的設計或如圖七所示，係本創作電解拋光之長管內一較佳實施例，即一螺旋導軌24，以將電解時所產生之氣泡快速排除；一驅動機構27，係包含複數個外電磁鐵271，以均勻的環狀分布環繞設置於該長管16外，且相對於該長管16內之固定磁鐵機構28的位置，並連接一第二電源裝置30，以提供該複數個外電磁鐵271的電源供應；以及一軸向機構22，係將該驅動機構27與該第二電源裝置30共同設置於其上，以提供該機構與裝置之軸向運動，其速度約為5至20cm/min。以上所述之電極21、二隔板18、26與固定磁鐵機構28係裝置於長管16內，並配合驅動機構27，即當驅動機構27與該第二電源裝置30通電引起其內的複數個外電磁鐵271動作時，其電磁力會引動固定磁鐵機構28內之複數個固定磁鐵281作用，進而使電極21、二隔板18、26與固定磁鐵機構28進行自轉運動；該軸向機構22係同時驅動驅動機構27與第二電源裝置30，因此，該裝置將進行管內的軸向運動；並且，當電極21與該第一電源裝置29通電時，即可互相配合形成一完全之長管內面電解拋光反應。

如上所述，該驅動機構27可以是一電磁機構，當驅動機構27與第二電源裝置30通電時，引動驅動機構27內的複數個外電磁鐵271交互變換，進而帶動固定磁鐵機構28內複數個固定磁鐵281作轉動運動，其速度約為10至200rpm；或者，該驅動機構27係一機械轉動機構，當驅動機構27與第二電源裝

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五、創作說明（9）

置30通電時，直接以機械傳動的方式轉動驅動機構27內的複數個外電磁鐵271，進而帶動固定磁鐵機構28內複數個固定磁鐵281作轉動運動。

請參考圖四所示，係本創作電解拋光研磨實際應用之簡單圖，且為電解研磨拋光之一較佳實施例。所不同的是本實施例係將電極置於前方，電極之前端亦繫有一導電電纜20，並接上一第一電源裝置29；另一方面，當電解研磨拋光的動作正進行時，一軸向機構22係由高處往低處移動，以便利研磨後的顆粒之排除。

請參考圖五所示，係本創作電解拋光研磨之長管內一較佳實施例之局部放大圖，為應用於拋光研磨至少一內部充滿電解液長管16之管徑內面，且該長管16之長度係大於3公尺，並以SUS300系列之無極性材料製成，包括有：一固定磁鐵機構28，係包含複數個固定磁鐵281，以每單一磁鐵的最長邊為軸向邊界而成型為固定磁鐵機構28；至少一電極21，係以銅或鎢材質製成，該電極21之一端係繫有一導電電纜20，該導電電纜20外接於該長管16外之一第一電源裝置29，以提供電源；至少二隔板，係由鐵氟隆(Teflon)或不導電材質製成，為限制電解拋光範圍，主要可節省總電源使用，並加強電解拋光效果，本實施例亦可如圖三所示一樣，該第一隔板18之週邊係設計有溝槽25，以帶動管壁邊緣之電解液流動，破壞其邊界流效應，使陽極膜均勻化的產生，更可有效地將電解所產生的氣泡快速排除；另有如圖三所示一樣，為使電解液流動不受限制，該第一隔板18與26可鑽複數個孔34，如

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五、創作說明（10）

網狀分布，以順暢導通電解液流動；且為避免導負電之電極21與導正電之管壁接觸，而造成短路影響製程品質，以及解決電極偏心所造成電解拋光不均勻等現象，第一隔板18之尺寸不需加大，係驅動機構27〈圖五未示〉與固定磁鐵機構28通電後形成一磁浮效應，即磁性兩極的相吸與排斥使隔板不致碰觸管徑內面與避免偏心現象；其中第一隔板18係裝設於該電極21連接該導電電纜20之端的相反端，另一第二隔板26係沿著軸向隔著該固定磁鐵機構28與該第一隔板18分別設置於該固定磁鐵機構28之兩端，且該固定磁鐵機構28係呈徑向均勻分布於該二隔板上；請參考圖六所示，係本創作電解拋光研磨中隔板之一較佳實施例剖面圖，從該第二隔板26之徑向端面係設有複數個封閉式凹槽，以在該複數個凹槽內各設置一彈簧33與一頂出物35，該各頂出物35係凸出於第二隔板之徑向端面外，並各頂住一研磨物32，係由三氧化二鋁(Al_2O_3)所製成，且該各研磨物32係頂住長管內面，進行研磨的動作；本實施例以下各元件係可如圖二所示一樣，因圖五係一局部放大圖示，故請參考圖二，包括一驅動機構27，係包含複數個外電磁鐵271，以均勻的環狀分布環繞設置於該長管16外，且相對於該長管16內之固定磁鐵機構28的位置，並連接一第二電源裝置30，以提供該複數個外電磁鐵271的電源供應；一軸向機構22，係將該驅動機構27與該第二電源裝置30共同設置於其上，以提供該機構與裝置之軸向運動，其速度約為5至20cm/min。以上所述之電極21、二隔板18、26與固定磁鐵機構28係裝置於長管16內，並配合驅動機構27，即當驅動機

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五、創作說明（11）

構27與該第二電源裝置30通電引起其內的複數個外電磁鐵271動作時，其電磁力會引動固定磁鐵機構內之複數個固定磁鐵281作用，進而使電極21、二隔板18、26與固定磁鐵機構28進行自轉運動；該軸向機構22係同時驅動驅動機構27與第二電源裝置30，因此，該裝置將進行管內的軸向運動；並且，當電極21與該第一電源裝置29通電時，即可互相配合形成一完全之長管內面電解拋光研磨的加工。

如上所述，該驅動機構27可以是一電磁機構，當驅動機構27與第二電源裝置30通電時，引動驅動機構27內的複數個外電磁鐵271交互變換，進而帶動固定磁鐵機構28內複數個固定磁鐵281作轉動運動，其速度約為10至200rpm；或者，該驅動機構27係一機械轉動機構，當驅動機構27與第二電源裝置30通電時，直接以機械傳動的方式轉動驅動機構27內的複數個外電磁鐵271，進而帶動固定磁鐵機構28內複數個固定磁鐵281作轉動運動。

本創作之電極係非只限定於一隻，亦可隨實際需求可擴充至多段式的電極設計，以增進其電解拋光與研磨的效果。因此，綜觀以上所述，本創作實在地與巧妙地將普通的裝置互相配合應用，達到意想不到的效果。

以上之說明乃本創作之較佳實施例，本創作所涵蓋之範圍並不限於本創作所示之實施例，凡依本創作內容所作之改變，並且可由熟知該技藝人員所構想者，均屬本創作所涵蓋之範圍者，且本創作申請前亦未見於任何刊物或公開場合，其新穎性毫無疑慮，誠已符合新型專利法所規定之要件，故

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五、創作說明（12）

爰依法呈提新型專利之申請，尚祈　貴審查委員允撥時間惠予審查，並早日賜與專利實為感禱。

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六、申請專利範圍

1. 一種長管內表面電解拋光裝置，係應用於拋光至少一內部充滿電解液長管之管徑內面，其包含有：

一固定磁鐵機構，係包含複數個固定磁鐵，以每單一磁鐵的最長邊為軸向邊界而成型為一體；

至少一電極，該電極之一端繫有一導電電纜，該導電電纜外接於該長管外之一第一電源裝置，以提供電源；

至少二隔板，其中一第一隔板係裝設於該電極連接該導電電纜之端的相反端，另一第二隔板係沿著軸向隔著該固定磁鐵機構與該第一隔板分別設置於該固定磁鐵機構之兩端，且該固定磁鐵機構係呈徑向均勻分布於該二隔板上；

一驅動機構，係包含複數個外電磁鐵，以均勻的環狀分布環繞設置於該長管外，且相對於該長管內之固定磁鐵機構的位置，並連接一第二電源裝置，以提供該複數個外電磁鐵的電源供應；以及

一軸向機構，係將該驅動機構與該第二電源裝置共同設置於其上，以提供該機構與裝置之軸向運動；

以上所述之電極、二隔板與固定磁鐵機構係裝置於長管內，並配合驅動機構，即當驅動機構與該第二電源裝置通電引起其內的複數個外電磁鐵作時，其電磁力會引動固定磁鐵機構內之複數個固定磁鐵作動，進而使電極、二隔板與固定磁鐵機構進行自轉運動；該軸向機構係同時驅動驅動機構與第二電源裝置，因此，該裝置將進行

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六、申請專利範圍

管內的軸向運動；並且，當電極與該第一電源裝置通電時，即可互相配合形成一完全之長管內面電解拋光反應。

2. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該隔板係由不導電材質製成。

3. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該隔板之週邊係設計有溝槽，以帶動管壁邊緣之電解液流動。

4. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該隔板係具有複數個孔洞，如網狀般分布，以順暢導通電解液流動。

5. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該隔板之尺寸不需加大，係驅動機構與固定磁鐵機構通電後形成一磁浮效應，即磁性兩極的相吸與排斥使隔板不致碰觸管徑內面與避免偏心現象。

6. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該第二隔板連接固定磁鐵機構之面的相反面係裝設一螺旋機構，以將電解時所產生之氣泡快速排除。

7. 如申請專利範圍第6項所述之一種長管內表面電解拋光裝置，其中，該螺旋機構係下列任一種：螺旋槳、螺旋導軌。

8. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該驅動機構係一電磁機構，當驅動機構與第二電源裝置通電時，引動驅動機構內的複數個外電磁

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六、申請專利範圍

鐵交互變換，進而帶動固定磁鐵機構內複數個固定磁鐵作轉動運動。

9. 如申請專利範圍第1項所述之一種長管內表面電解拋光裝置，其中，該驅動機構係一機械轉動機構，當驅動機構與第二電源裝置通電時，直接以機械傳動的方式轉動驅動機構內的複數個外電磁鐵，進而帶動固定磁鐵機構內複數個固定磁鐵作轉動運動。

10. 一種長管內表面電解拋光研磨裝置，係應用於拋光研磨至少一內部充滿電解液長管之管徑內面，其包含有：

一固定磁鐵機構，係包含複數個固定磁鐵，以每單一磁鐵的最長邊為軸向邊界而成型為一體；

至少一電極，該電極之一端繫有一導電電纜，該導電電纜外接於該長管外之一第一電源裝置，以提供電源；

至少二隔板，其中一第一隔板係裝設於該電極連接該導電電纜之端的相反端，另一第二隔板係沿著軸向隔著該固定磁鐵機構與該第一隔板分別設置於該固定磁鐵機構之兩端，且該固定磁鐵機構係呈徑向均勻分布於該二隔板上，其中，從該第二隔板之徑向端面係設有複數個封閉式凹槽，以在該複數個凹槽內各設置一彈性元件與一頂出物，該各頂出物係凸出於第二隔板之徑向端面外，並各頂住一研磨物，且該各研磨物係頂住長管內面，進行研磨的動作；

一驅動機構，係包含複數個外電磁鐵，以均勻的環狀分布環繞設置於該長管外，且相對於該長管內之固定磁鐵

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六、申請專利範圍

機構的位置，並連接一第二電源裝置，以提供該複數個外電磁鐵的電源供應；以及

一軸向機構，係將該驅動機構與該第二電源裝置共同設置於其上，以提供該機構與裝置之軸向運動；

以上所述之電極、二隔板與固定磁鐵機構係裝置於長管內，並配合轉動機構，即當驅動機構與該第二電源裝置通電引起其內的複數個外電磁鐵動作時，其電磁力會引動固定磁鐵機構內之複數個固定磁鐵作用，進而使電極、二隔板與固定磁鐵機構進行自轉運動；該軸向機構係同時驅動驅動機構與第二電源裝置，因此，該裝置將進行管內的軸向運動；並且，當電極與該第一電源裝置通電時，即可互相配合形成一完全之長管內面電解拋光研磨的加工。

11. 如申請專利範圍第10項所述之一種長管內表面電解拋光裝置，其中，該第一隔板之週邊係設計有溝槽，以帶動管壁邊緣之電解液流動。

12. 如申請專利範圍第10項所述之一種長管內表面電解拋光裝置，其中，該第一隔板係具有複數個孔洞，如網狀般分布，以順暢導通電解液流動。

13. 如申請專利範圍第10項所述之一種長管內表面電解拋光裝置，其中，該第一隔板之尺寸不需加大，係驅動機構與固定磁鐵機構通電後形成一磁浮效應，即磁性兩極的相吸與排斥使隔板不致碰觸管徑內面與避免偏心現象。

14. 如申請專利範圍第10項所述之一種長管內表面電解拋光

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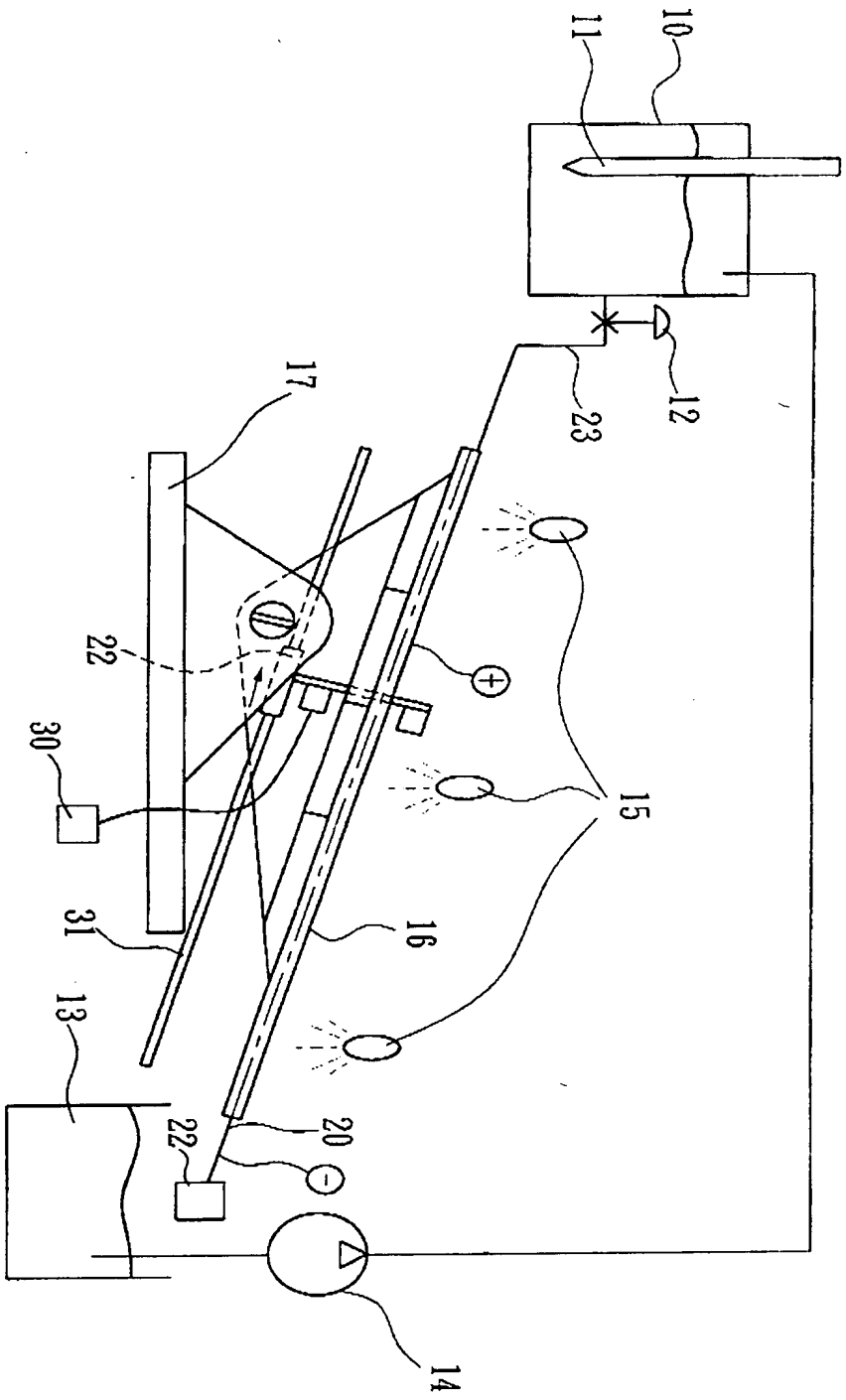
六、申請專利範圍

裝置，其中，該彈性元件係一種彈簧。

15. 如申請專利範圍第10項所述之一種長管內表面電解拋光裝置，其中，該研磨物係由三氧化二鋁(Al_2O_3)所製成。

16. 如申請專利範圍第10項所述之一種長管內表面電解拋光裝置，其中，該驅動機構係一電磁機構，當驅動機構與第二電源裝置通電時，引動驅動機構內的複數個外電磁鐵交互變換，進而帶動固定磁鐵機構內複數個固定磁鐵作轉動運動。

17. 如申請專利範圍第10項所述之一種長管內表面電解拋光裝置，其中，該驅動機構係一機械轉動機構，當驅動機構與第二電源裝置通電時，直接以機械傳動的方式轉動驅動機構內的複數個外電磁，進而帶動固定磁鐵機構內複數個固定磁鐵作轉動運動。



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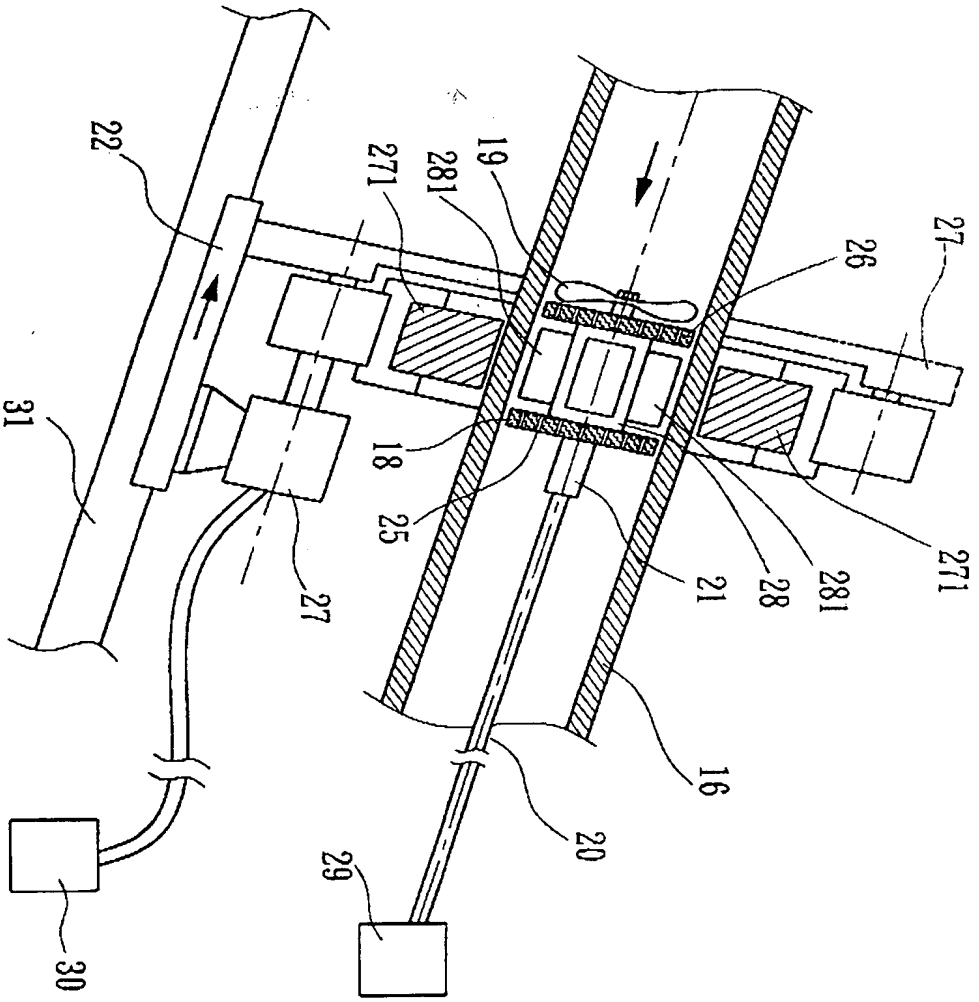
圖一



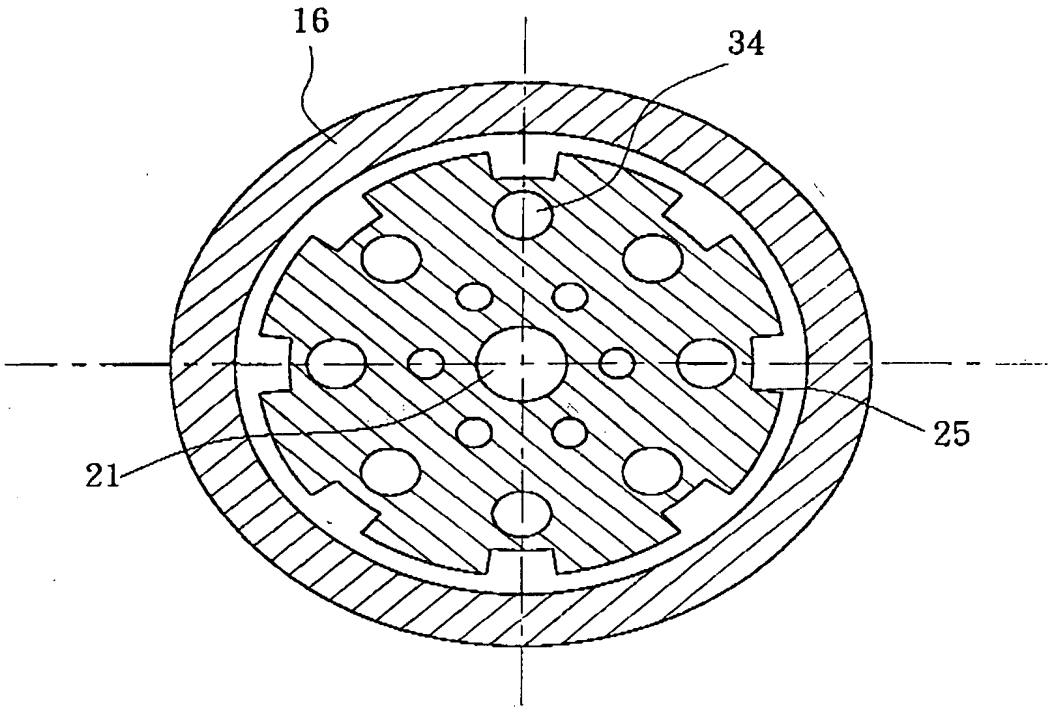


圖 三

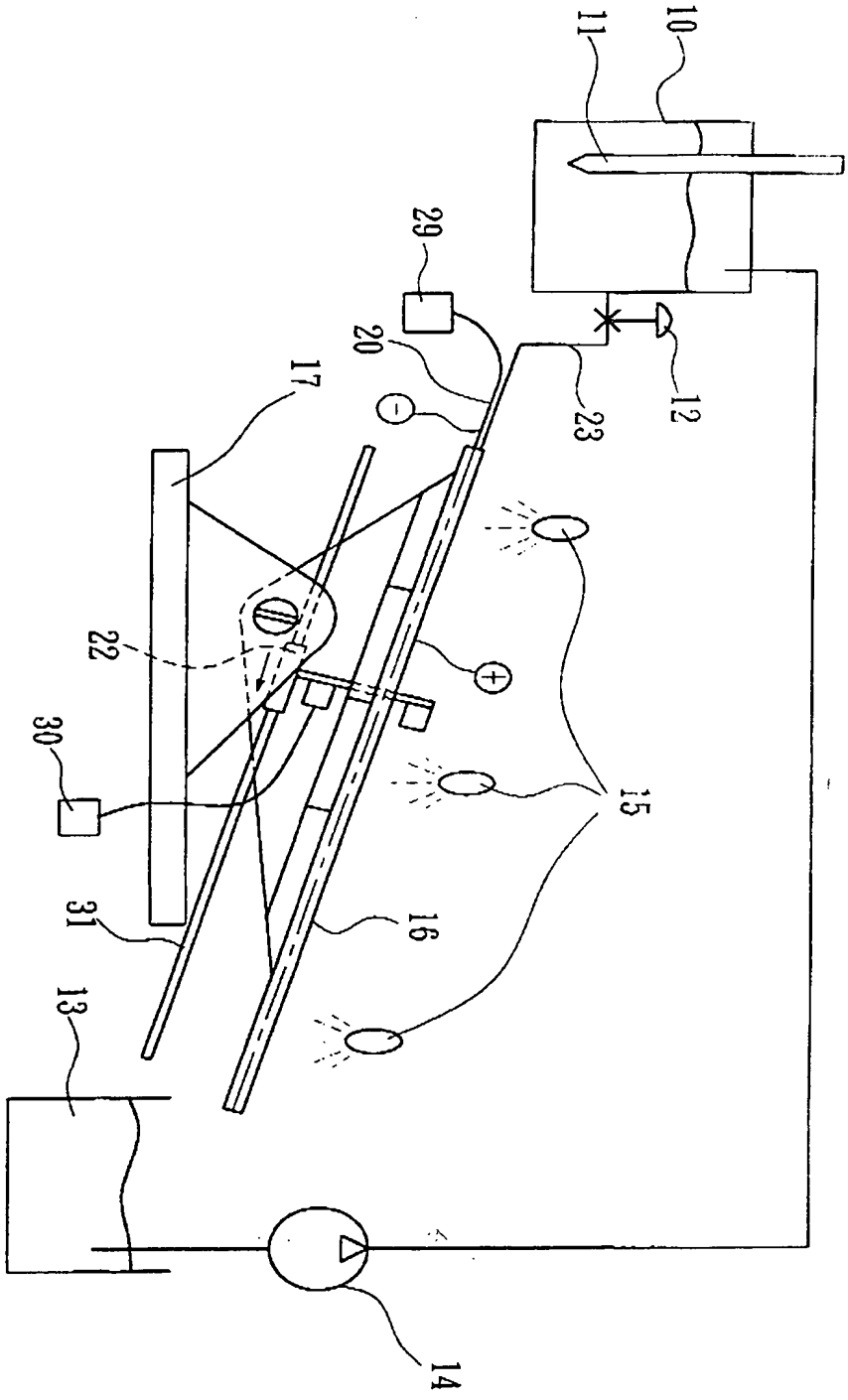


図 5

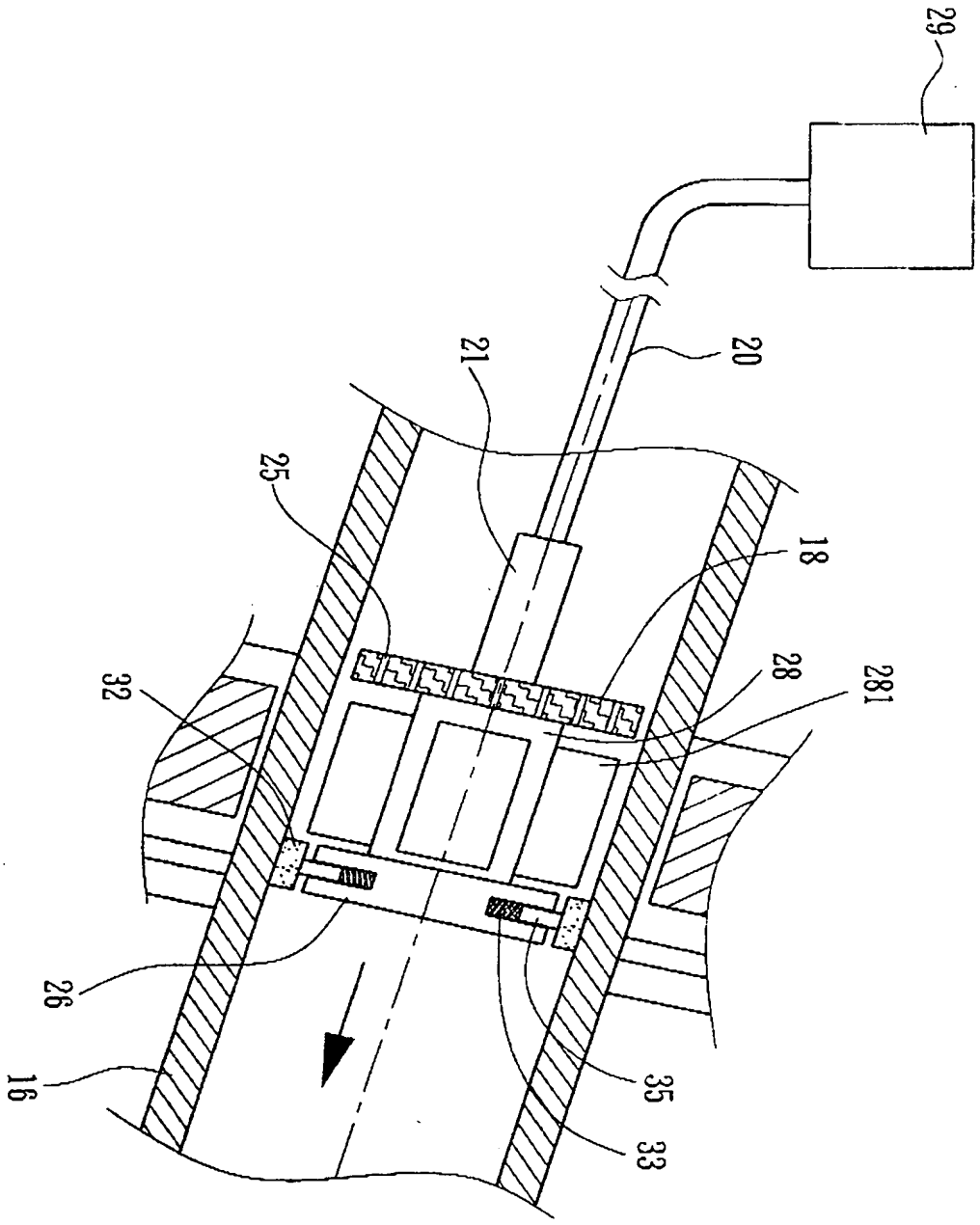


図 五

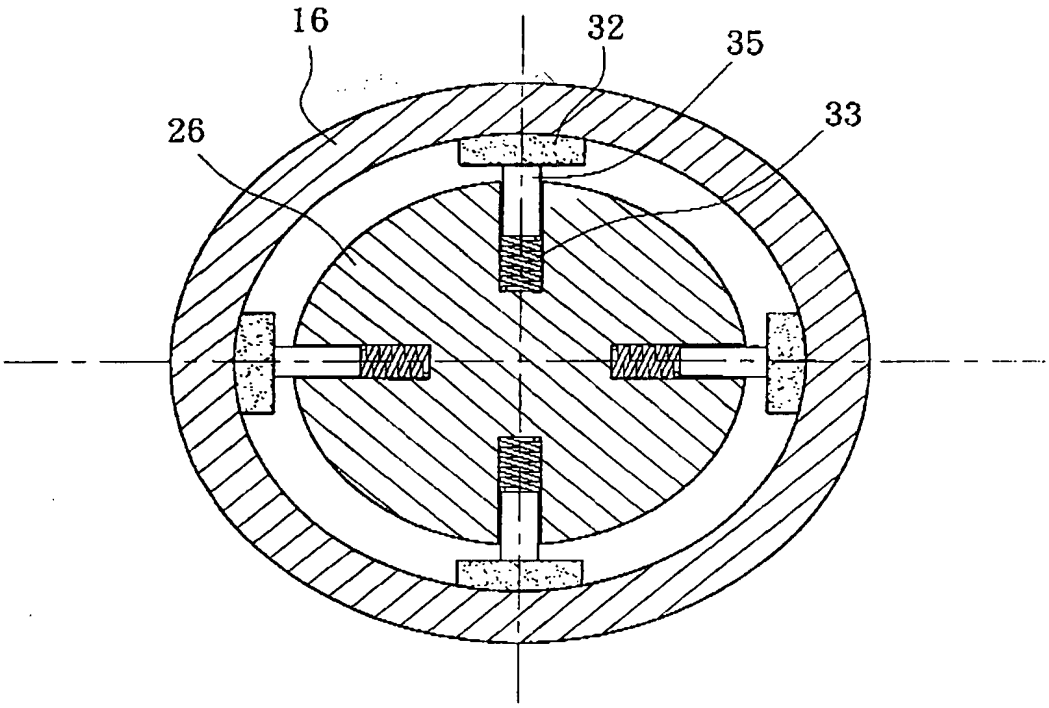


圖 六

圖十